CHEMICAL HERITAGE FOUNDATION

EDWARD DONLEY

Transcript of an Interview
Conducted by

James J. Bohning

at

Belleair, Florida

on

26 January 1995

(With Subsequent Corrections and Additions)

DONLEY

CHEMICAL HERITAGE FOUNDATION
Oral History Program
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EDWARD DONLEY

1921 Born in Highland Park, Michigan, on 26 November

Education

1943 Bachelor of Mechanical Engineering, Lawrence Technical University
1959 Advanced Management Program, Harvard University

Professional Experience

Air Products and Chemicals, Inc.
1943-1946 Draftsman

Continental Aviation
1946-1949 Engineer

Air Products and Chemicals, Inc.
1949-1951 Engineer
1951-1952 Engineering Manager
1952-1954 Sales Engineer
1954-1959 Vice President of Sales
1959-1966 Vice President and General Manager
1966 Executive Vice President
1966-1978 President
1973-1986 Chief Executive Officer
1978-1986 Chairman of the Board
1986-1992 Chairman, Executive Committee

1992-1994 Chairman of the Board, American Standard, Inc.

Honors

1978 Honor Award, Commercial Development Association
1980 Chemical Industry Medal, Society of Chemical Industry
1977 Doctor of Industrial Management, Lawrence Technological University
1978 Doctor of Commercial Science, Villanova University
1978 Doctor of Laws, Lehigh University
1979 Doctor of Humane Letters, Muhlenberg College

1980	Doctor of Laws, Allentown College
1980	Doctor of Science, Cedar Crest College
1981	Doctor of Commercial Science, Drexel University
1984	Doctor of Humane Letters, Wilkes College
1986	Doctor of Humane Letters, Lafayette College
1987	Doctor of Laws, Moravian College
1987	Doctor of Humanities, Lawrence Technological University

ABSTRACT

The interview begins with Edward Donley describing his early years growing up on his family's farm and attending a one-room schoolhouse. After graduating from high school, Donley joined the Civilian Conservation Corps and, after applying to several colleges, attained a scholarship to Lawrence Technological University in Detroit, Michigan. As a senior working towards a Bachelor of Mechanical Engineering, Donley began mechanical drafting work part-time for Detroit's newly established Air Products company. Donley describes his college education during the war and compares his life-long experiences with Lawrence Tech and Air Products, watching both institutions develop from fledgling to flourishing. During Donley's early career, Air Products' work involved military contracts to develop portable units for extracting oxygen from the air. With the cancellation of military contracts after World War II, the company declined and Donley went to work temporarily for Continental Aviation and Engineering Company, returning after Air Products moved to Emmaus, Pennsylvania, to rebuild. Donley recalls his professional development as a manager and engineer, and his close relationship with mentor Leonard Pool. As Air Products grew through the contributions of Pool, Carl Anderson, and others, Donley rose through the ranks to take on increasing responsibility, eventually playing a large role in developing liquid oxygen plants first to fulfill Air Force contracts and later for commercial production. Donley next details Air Products' involvement with hydrogen for ammonia production, and eventually with liquid hydrogen. He describes the recruitment and contribution of several engineers and managers, the change in Air Products' work environment from family to professional emphasis, and the reasons and strategy of the company's move into the chemical business. In the final section of the interview, Donley examines his presidency, beginning with Pool's gradual transfer of responsibility, the origins and emphasis of Air Products' environmental division, and the institution of the matrix management system. He discusses his views on the role of engineering in long-term planning, and the importance of recruitment, career development, and safety programs; he also describes several important individuals who contributed to Air Products' later development. He closes with comments on American educational reform and entrepreneurial efforts, scientific innovation, changes in management agendas over the years, and federal regulation of business.

INTERVIEWER

James J. Bohning is Professor of Chemistry Emeritus at Wilkes University, where he was a faculty member from 1959 to 1990. He served there as chemistry department chair from 1970 to 1986 and environmental science department chair from 1987 to 1990. He was chair of the American Chemical Society's Division of the History of Chemistry in 1986, received the Division's outstanding paper award in 1989, and presented more than twenty-five papers before the Division at national meetings of the Society. He has been on the advisory committee of the Society's National Historic Chemical Landmarks committee since its inception in 1992. He developed the oral history program of the Chemical Heritage Foundation beginning in 1985, and was the Foundation's Director of Oral History from 1990 to 1995. He currently writes for the American Chemical Society News Service.

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INTERVIEWER: James J. Bohning

LOCATION: Belleair, Florida

DATE: 26 January 1995

BOHNING: I know that you were born in Highland Park, Michigan, on November 26, 1921. Could you tell me a little bit about your father and mother and your family background?

DONLEY: My father and mother came from farm communities in Michigan. My father worked in Detroit for a few years in the 1920s, before the Depression. Then when the Depression came, we left Detroit—he was unemployed—and settled on the family farm that had been in my father's family for several generations. We lived there throughout the Depression until I went away to college in 1939.

My father and mother had both been, in their youth, schoolteachers. In those days, they had what they called normal schools, in Michigan and in other states. People could go to these schools for two years and get a teacher's certificate, or something like that, which made them eligible to teach in the public schools. Both of them did that for a few years. Then, from the beginning of the Depression on, my dad and all of us went back to the business that he'd been in when he was a child, and his father, and his father before him: working the land on the farm.

BOHNING: Where did you receive your early schooling?

DONLEY: I went to the local schools there. The grade school I went to, it was called the Claggett School. In that area, in those times, they had one-room schoolhouses dotted around the countryside, and they were separated by about two or three miles. The one whose district we lived in was about a mile and a half from where we lived. I went to that school.

Actually, I'm very active in education reform now. I think there's a lot to be said for the old one-room schoolhouse, with one teacher and eight grades in the school. It just had one room. Instead of the teacher, as in conventional practice now, standing and lecturing to a class of kids all the same age, these kids learned from each other. There was a real sense of community in that little schoolroom.

But anyway, that's what I did. Then when I went to high school, I went to a local, small high school. When I graduated, there were eight kids in my graduating class.

BOHNING: Where was the high school?

DONLEY: Well, the town has since disappeared. The name of the town was Lenox, but it was just a little small community, and it doesn't exist any more. It's been incorporated in a somewhat larger town called Richmond. That's in Macomb County, in Michigan.

BOHNING: You were the oldest of six children?

DONLEY: Eight children.

BOHNING: Eight children. It must have been difficult times, with the Depression and living off the land, as you say.

DONLEY: Well, it was difficult and we were poor, but everybody was poor.

This is a house, a log cabin, that was built by my great-grandfather in the 1850s. That's where we lived. That still exists. We still own the land around it, pay the taxes, and rent the land. Inez [C. Donley], my three children, and their equivalent from the other branches of our family treat this old house now as kind of a shrine.

BOHNING: I can imagine, yes. [laughter]

DONLEY: Our family lived there for one hundred years.

BOHNING: That's incredible.

DONLEY: Of course, the ones who think it's wonderful to preserve that shrine are not the generation who presently pay the taxes. [laughter]

BOHNING: Is it pretty much built up around there now?

DONLEY: No, it's still pretty rural.

BOHNING: Is it really?

DONLEY: Yes. That's at the north end of the county. The industrialization is at the south end of the county. That's in the congressional district represented by Mr. [David E.] Bonior, the Democratic whip in the House now.

When my great-grandfather came there in 1850—he came in 1848; I think the house was built in 1850—it was on the edge of civilization, really. He bought the land and worked it. Then his son did. Then, his son, my father, did. We did when we were children.

BOHNING: When you got to high school, had you given any thought to what you wanted to do beyond that?

DONLEY: My mother and father—my mother in particular, but my father, too—always, always talked about the university. When I look back on it now, I don't know what university they meant. I guess they meant the University of Michigan. But it was just a foregone conclusion that those of our family—myself, my brothers, and a sister—would go to the university.

Well, when I finished high school, I didn't have any idea how to go to the university. We didn't have high school counselors or anything. In that rural high school that I went to, I don't think anyone had ever gone to college. Nobody in my class of eight students did.

I hitchhiked to Ann Arbor one day, when I was about sixteen, and talked to the people there. I could get a job in the old hotel there, but it just wasn't enough—I couldn't put the thing together for the tuition and so forth, even in a state university. Then, to my dismay, I found out that the high school that I was just about to graduate from was not accredited by the University of Michigan. So I gave up that idea.

I tried to get a job, and there weren't any jobs. My father didn't want me to stay on the farm. He wanted me to go and do something different. So I joined the CCC.

BOHNING: Civilian Conservation Corps?

DONLEY: Yes. I was sent to a place in northern Michigan. It was run by the army in those days. The commanding officer, at the place I was, was a Major Hambleton. He took me out of the field forces, where they were planting trees and so forth, and made me his clerk in the office. I didn't really have much to do there, so I spent a lot of time writing letters to colleges—every place I could think of. I'd had all As in my high school transcript. Finally, late that summer, I got a letter from Lawrence Tech, inviting me to come to school there and offering free tuition, semester by semester, as long as I maintained a B-plus average.

That was in Detroit. I had confidence that I could get some kind of part-time work in Detroit. So I went down there and went to school. I did get a job at Sears Roebuck, worked there on evenings and Saturdays, and had the free tuition. Four years later, I got my engineering degree.

BOHNING: Were there dormitories on campus, or did you live in a rooming house?

DONLEY: In a rooming house. I just retired from the board of Lawrence Tech. I was chairman there for many years. Lloyd Reuss, the former president of General Motors, has been on the board a long time. He's chairman now, and we have a new president. But the college—now called the university—has a history parallel to Air Products. I played a comparable role, I guess, in both of these institutions.

When I went to Lawrence Tech, it was a new school. It had been created in 1932 or 1933 by the Dr. [Russell E.] Lawrence, who had been dean of engineering at the University of Detroit and had had some conflict with the management there. When I went there, it had three or four hundred students, and it was operated from rented facilities. Now today, fifty-odd years later, it's on a really striking modernistic campus in Southfield, outside of Detroit, and it has six thousand students. It's got a very limited endowment, unfortunately. But it came from just a little seed into a really very significant institution.

BOHNING: Wilkes College started in 1933. That's a very unusual time to be starting an educational institution, in the depths of the Depression.

DONLEY: Yes. Well, I'm jumping around, but before I got my degree, I was working on odd, various things. Some courses I took in the evening, some courses I took in the day. I had different kinds of jobs. I got a job then at Air Products in the spring of 1943, before I got my degree in June. I worked part-time at Air Products, got paid seventy cents an hour. But it was a

new company. It had, I think it was, ten employees. The records aren't clear anymore, but it was a very small number of employees.

BOHNING: Was this in the Detroit area?

DONLEY: Yes, it was in Detroit at that time. So I had a marvelous experience of seeing and participating in Lawrence Tech growing from a very questionable, whether-it-would-survive type of school, into a well-established institution. Air Products, the same thing.

BOHNING: You said Lawrence Tech had about four hundred students when you were there. What were the faculty members like? Did the school emphasize engineering?

DONLEY: Yes. The faculty at that time were mostly associates of Dr. Lawrence—who, as I said, had been dean at the University of Detroit. There were maybe half a dozen permanent faculty. A relative of Dr. Lawrence was the administrative officer who ran the administration. Most of the other faculty were what we would now call adjunct professors, who were in the engineering departments at Ford or Chrysler—or General Motors, mostly. They came there and taught a few courses.

BOHNING: The emphasis was on mechanical engineering, then.

DONLEY: And architecture. Today the university produces mostly undergraduate degrees, but it gives a smattering of master's degrees in business, engineering, and architecture. It's still a small target school with those disciplines. They existed then. Engineering and architecture were the predominant curricula, even back in those days. Architecture there, then and still, means mostly industrial architecture. The graduates of that school of architecture generally get jobs in big companies or architectural firms, doing work for industrial manufacturing companies and things of the sort.

There was, for many years—while I was there, too—a degree in chemical engineering, but that's not the course I took. I took the course in mechanical engineering.

BOHNING: Was there any reason why you selected mechanical engineering?

DONLEY: I think that I felt that I could master that easier than chemical engineering. The high school education that I had, I had never had a course in chemistry. I mean, it just wasn't a very advanced high school.

BOHNING: Was mathematics a strong point in your background?

DONLEY: Not in high school. In college, I really had a tough time with math. I had to preserve this B-plus average, or I lost my scholarship. It was hard for me. There were a lot of kids in Lawrence Tech in those days who had gone to really good high schools. Cast Technical High School in Detroit, for example, was preeminent. I don't remember what level of mathematics they had had—but I had never had a course in algebra, even, until I got in college. I remember, boy, differential equations put fear in my heart. [laughter]

BOHNING: The war was going on.

DONLEY: The war was going on. The war started of course in 1939. Then in 1941 when the United States got in, I was deferred from military service while I was in the undergraduate school. At one time, I was overcome with a patriotic fever, and I tried to enlist in the officer training school in the air force. It was discovered that I had a mild heart murmur. That was fairly early in the war. Well, that was a knockout, as far as officer training school was concerned. I just went back to school and stuck to it. Then, by the time I got into my senior year, all the services were really drafting people who would not have been eligible in the early part of the war. But by then, I was working at Air Products. We had these military contracts, and that resulted in my not being drafted.

BOHNING: When you had this first job with Air Products, before you graduated from Lawrence, what was your assignment?

DONLEY: I was doing mechanical drafting. I was taking quite a few morning classes then. Air Products' office was near the school, a mile away. I would come to the company at 2:00 p.m. or 3:00 p.m. in the afternoon. The company only had two or three engineers at that time, maybe four. They were working on these designs, mostly for the military. They'd have design layouts, and then I would start making the detailed drawings on a drafting board. I could stay there as long as I wanted—until eight, nine o'clock at night—and get paid my seventy cents an hour. So that's what I did.

Then in June of that year, which was 1943, I got the degree. There were two alternatives in degrees. Nobody outside the campus knew the difference between them, or even cared. One was a bachelor of science in mechanical engineering, and the other was a bachelor of mechanical engineering. The difference between the two was that, to get a bachelor of mechanical engineering, you had to do a project, and research and write on it. On the campus, the mechanical engineering degree was considered more significant than a bachelor of science degree.

So I went for that degree. I set up an experiment to measure the heat transfer coefficient on heat exchangers, which related to what I was doing at Air Products. I had to intertwine the afternoons and evenings at Air Products with conducting my research project as well.

BOHNING: How many students graduated with you?

DONLEY: I would say it was about sixty.

BOHNING: Had the war taken a number of students away?

DONLEY: Well, as time went on, the war did take a number of students away, yes. The class of 1943, as I recall, had about sixty. The class of 1944 had maybe twenty, or something like that. I've forgotten the subsequent years it started to build up. Then the company moved to Tennessee. We were there during the war. Then when the war ended, we moved to Pennsylvania.

It was probably about 1950 or something when Dr. Lawrence had died, and his younger brother [E. George Lawrence] was president of the college. He asked me to join the board of trustees, which I did. Then after a few years, I became chairman. I continued that activity all the years I was at Air Products, until last year. In 1994, I became emeritus chairman, and the other guy became chairman.

BOHNING: You were chairman for around forty-five years.

DONLEY: No, I must be off. I think it was twenty-five years, so I must be off on the dates somehow. Oh, I was on the board for some years before I became chairman.

BOHNING: You were on the board of trustees for approximately forty-five years.

DONLEY: Something like that, yes.

BOHNING: Was it preordained that you'd go to Air Products when you got your degree?

DONLEY: No. I didn't know where I would go. I hadn't even heard of Air Products.

I met Leonard [P.] Pool. He was always interested in engineers and engineering. He wasn't trained as an engineer, but he had an intuitive judgment about engineering and about technology—particularly the commercial side of marketing technology. He used to come over there on the campus and talk to professors and students. I met him. I've forgotten exactly the details, but I somehow came to be offered a job part-time at Air Products first. Later, full-time.

You might be interested in this. Briefly, the war was going on. The German air force was bombing London, and the British were making the initial bombing raids over Germany. Of course, the U.S. Army Air Corps officers were observing those things. If you'll recall, the first Royal Air Force bombing over Germany was devastating to the British. The Germans had anti-aircraft guns that knocked them out of the sky. It became clear that, in order to carry out operations of this kind, the aircraft would have to go to a very high altitude. That meant they had to have oxygen for the pilots' breathing.

The concept on which Air Products had been created was that, rather than producing oxygen in large central industrial gas plants and delivering it to users, for large users you could develop a miniaturized plant and extract oxygen from the air, on-site. Then you could pipe it into the steel mill or whatever.

Leonard Pool, with Carl [R.] Anderson, had started the company based on developing that concept. They were working on it and were undercapitalized—really, were broke. The military who were at Wright Patterson Air Force Base in Ohio let out an inquiry for developing a portable unit for extracting oxygen from the air that would be of such size, it could be transported by air to air bases around the world. There were several large corporations who bid on that. Air Products bid. But Air Products had <u>already</u> been working on the idea for commercial purposes, more quickly than anybody else. That's when I came to work there the first time, when I worked part-time. That was just getting underway. They developed what became the successful U.S. government-accepted model.

Then the government wanted hundreds of these built. If you can believe it or not <u>now</u>, Detroit had negative unemployment in those days. The government had set up a factory in Chattanooga in which they had intended, originally, to manufacture tanks. So they sent Air Products to Chattanooga. We only had, I think, nineteen people who went there, moved into

this partially completed factory, and started manufacturing these things. We did that on until the end of the war.

[END OF TAPE, SIDE 1]

BOHNING: What was your role in that process?

DONLEY: Well, my role at the beginning was as a detail design draftsman. Then, of course, the company was expanding at an enormous rate. As I said, when I came in 1943, it had perhaps one dozen employees. By the end of the war, it was approaching one thousand. I was in charge of the engineering department. We were building these units for all of the Allied governments: the British, the Russians, the Belgians, et cetera. When the war ended, why, immediately those contracts were all canceled. That was a stunning blow to the company, which hadn't really made any profit during the war; because the excess profit taxes, the renegotiations of the contracts, the facilities we occupied, and even the working capital were provided by the government. So the company didn't prosper, financially, by the war. That was proper, you know. But the company did get a lot of technical know-how.

It was a stunning blow. The company survival was really questionable. I went with another group for a few years. We had a company that had made the engines for the plants we were building during the war, Continental Aviation and Engineering Company. It doesn't exist anymore. It's part of Teledyne now. It had contracts to bring over from Germany all kinds of equipment—including oxygen equipment, engines, compressors, the buzz bombs, and so forth—and experiment with those German devices, then write reports on technical characteristics which could be available to American business and American military. I did that for two or three years.

In the meantime, the company [Air Products] didn't want to stay in Chattanooga. Tennessee was a depressed part of the country in those days. It shows how much Detroit was prosperous and Tennessee was impoverished—the reverse of now. But it appeared that the principal market for the original concept of producing oxygen to sell on-site to large users was in the steel industry. So the company found this place in Pennsylvania. A used factory was available in Emmaus, Pennsylvania. The company came there and then began the recovery from the war. I came there in 1950, after being off on this other thing for a few years. I've been there ever since.

BOHNING: You said that the company had one thousand employees at the end of the war. What happened to the work force at that point, when everything was cut back?

DONLEY: It was just all disbanded. I think, again, the company was back to around twenty people.

BOHNING: So by the time you got to Pennsylvania, that was your work force.

DONLEY: Yes, right. The company, in those early days in Pennsylvania, was really a manufacturing company producing this equipment. When we came there, this used factory in Emmaus was in the heart of the so-called Pennsylvania Dutch country. That was a very lucky, fortunate thing, because the Pennsylvania Dutch people are the kind of people who believe in a day's work for a day's pay. In that little, small business, starting up increment by increment, we had very reliable, conscientious workers available—factory workers.

BOHNING: In those very early days, what kind of interactions did you have with Leonard Pool?

DONLEY: Well, it was very close interaction—every hour, every day. He was, I think, about sixteen years older than I, and he didn't have any children. He was my mentor, and he treated me in some ways like a son. I resisted that—I didn't want to be his son. But it was a very close working relationship in all the years that we were together, until the time he died.

BOHNING: What was his management style like—specifically in that early time period, when the company was just getting started?

DONLEY: Well, his management style was very appropriate for a company of that size. He supervised everything; he had his finger in everything. He worked hard and continuously. Nothing escaped him. Now eventually, it came to the point when that sort of hands-on, personal, hour-by-hour management couldn't cope with the size of the company. He recognized that. It was in those transitions that he began really to assign more responsibility to me and others.

I didn't know anything about management. I didn't have any management experience, either. But I think temperamentally, I was more disposed to think about the organizational structure—assuming and transferring responsibility to others, and so forth—than Leonard was. He wanted me to go off—and I did go off—to the Harvard Business School for that fourteen weeks, or whatever it was. It was his hope that I would learn management skills. I suppose I did learn some. But I think what I learned, I learned mostly on the job. [laughter]

BOHNING: It was his doing that you went to Harvard for that program?

DONLEY: Yes.

BOHNING: I was going to ask, again, how much responsibility you had in those early days. Did you have to check with Pool in making important decisions?

DONLEY: Well, in the early days, everybody had to check everything with Leonard Pool. But as time went on, he weighed people. He came to really repose more responsibility in me. But I was always very sensitive about that, even until the time he died. I talked over with him important issues before establishing them as company policy. I'm jumping ahead—but years later, his wife Dorothy [R. Pool] got cancer and had a long suffering period. She died in the New York Sloan-Kettering Hospital. During the end of her illness, for several months, he had an apartment in New York and stayed there with her. He was very devoted to her and didn't want to leave her alone. I was de facto on a day to day basis running the company then. But I made a point of going and sitting down and talking over things with him, frequently.

BOHNING: Wasn't there a period when his brother [George F.] might have been the heir apparent?

DONLEY: Leonard's and George's background was this. Their father had been a welder on the railroad. They lived in Minneapolis. Their father died when they were very young—I think Leonard was sixteen. The mother was left in an impoverished condition with, I believe, three boys and a sister. I know there was a sister. Four children, the oldest of whom was Leonard, who was sixteen. He really assumed the role of the father and the breadwinner, and he got various kinds of jobs and supported them.

The next younger brother was George. Leonard eventually ended up in Detroit working for one of the industrial gas companies. Then he got George, who was seven or eight years younger than he, a job in the same company. They were both salesmen. There Leonard developed the idea that rather than producing this gas and then hauling it to where it was going to be used, make it at the site. George stayed. Leonard left and started Air Products. He borrowed money from his wife's father and from everybody he could. As I say, it was almost bankrupt until the military came along.

This is an important thing not to forget. He encountered Carl Anderson, who just died six months ago—he was born in 1898, and just died. Could I divert? He's an important part of this.

BOHNING: Oh, yes.

DONLEY: Andy's associate was a man, Lee S. Twomey. L. S. Twomey was a graduate of Purdue University in probably 1900, something like that. Twomey and Anderson used to tell me these stories when I was young. Thomas [A.] Edison started the Edison Electric Lamp Company in Cleveland, after they did the development work in New Jersey. They discovered, as everybody now knows, that if you put a tungsten filament in an argon atmosphere, you could make the incandescent lamp. The source of argon was from the old Linde Company in Munich, Germany. I've forgotten what Twomey told me they had to pay for a cylinder of argon—I think it was one hundred dollars.

Mr. Edison hired young engineers, and he hired Twomey. He said, "Your job is to design a unit to separate air and get argon, so we can make our own." Twomey didn't know anything about that, but he struggled along. He had a couple of engineers. After a few years, why, they had a unit that extracted argon. Mr. Edison had his argon.

Then Twomey encountered another entrepreneurial man who had the idea of using the know-how that they had developed to make oxygen. That's what the big industrial market was. So they formed a company called Gas Industries Company. It was located in Pittsburgh. From the time of World War I through the 1920s, they produced industrial gas plants. They sold them to various small entrepreneurs in cities all over the country to extract oxygen, pump it into cylinders, and sell it to welding shops, things like that.

In 1920, when Anderson got his engineering degree at Purdue, Twomey got him to come in to the Gas Industries Company. Andy worked there all those years. Then the Depression came, and there was nobody buying any oxygen plants at all. So the company went, really, out of business. It didn't go into bankruptcy, but it just simply went out of business. Andy had all of those engineering drawings and all that experience. When he and Leonard Pool met each other—in 1941, or something like that—that was the key to Pool making this idea <u>work</u>; because Anderson knew how to do it. That's how Anderson came into the picture.

Then, to come back to your early point, George came into the company about 1943. There was, of course, a real brotherly affinity between George and Leonard. When the first public stock was sold in 1946, Reynolds & Company was the securities firm that sold the stock. They really had financial control of the company. They had three directors, and they controlled it. They had confidence in Leonard, but they didn't have confidence in George. So Leonard

had a big battle with those people, and eventually they left the board. From then on, he had de facto control of the company.

Many people thought that George should be his successor. But the company was growing ever more technological. The engineering was getting more sophisticated and complicated. I was more or less looked upon as the engineering member of the team.

Anderson was a great engineer. He was a great engineer in the old sense. Andy always expected the management to decide what the engineers needed to do. Then if they decided what they wanted, we'd engineer it. Whereas I—for no reason, I guess, just my personality—was kind of the management and the engineer in the same person. As it became more complex from a technical standpoint, why, gradually Leonard—in the meantime, he had other outside directors on the board—moved toward my taking more and more responsibility. That eventually led to my becoming first the chief operating officer, and then the chief executive officer.

BOHNING: In those early days, this may have not had any significant meaning. However, what positions, if we could call them that, did you hold? You had started out in design work.

DONLEY: Yes.

BOHNING: What different kinds of positions did you hold, up until 1950?

DONLEY: I was called engineer, and then I was called engineering manager at one time. Then in the 1950s, I began to take a more active role in sales. We had, by that time, three or four salesmen. I said, "I don't want to have the title, salesman. I want to be sales engineer." So I had the title of sales engineer. Then I had the title, vice president of sales. In 1959, I was given the title of vice president and general manager, which was sort of like the chief operating officer. Then subsequently, I was executive vice president for a time, and then it was president. When I was president—we didn't use the terms then like they're used now, chief executive officer and chief operating officer—but during those years, using modern terminology, Leonard was the chief executive officer and I was the chief operating officer.

BOHNING: I've taken a few things from the book *Out of Thin Air* that might be interesting to comment on (1). I'm going back now to 1952, when you were a sales engineer. This passage concerns the military side of Air Products operations. In 1952, you were advocating that the military side of Air Products could be a commercial advantage.

DONLEY: Yes. What happened, in the development of the industrial gas industry, was that the on-site took a certain small market sector to supply large users. But all the rest of the vast industry was supplied by extracting oxygen, compressing it, putting it in cylinders, and delivering it to customers. That's very expensive, because a cylinder weighs fifteen times as much as the oxygen. During the 1930s, the one company—the Linde Division of Union Carbide—had developed the technology for producing liquid oxygen. For a vast array of middle-sized customers, that was the most efficient way to serve them. But nobody had the cryogenic technology to know how to do that.

We had learned some part from the German experience during World War II. They were producing liquid oxygen for their rockets, and we had the benefit of that background. It wasn't very helpful. The Germans, surprisingly enough, didn't keep very good records. But we had the benefit of that background. Then with the cold war going on, it was decided in the U.S. military that we would use liquid oxygen and hydrocarbon fuel for the ballistic missiles. So we were drawn back to the defense department.

Before, during the war, we were going to produce one ton a day of oxygen. Now they were talking ten, one hundred, one thousand, several thousand tons. So we started bidding on it and telling the government—the air force, by this time—what were their choices. The only American company that produced liquid oxygen was Linde. Linde said, "We'll supply all you need anywhere in the world. Just tell us what you want." We couldn't compete with that because we didn't have any production capacity.

You remember, [Franklin D.] Roosevelt had introduced rapid depreciation for government contractors during the war. They were able to put in large amounts of capital and write it down, and they had a written-down capital at the end of the war. Union Carbide and it's Linde division were <u>fabulously</u> wealthy then. They had a monopoly in this product, and they had low capital cost.

We just sat down and designed liquid-producing plants that we thought would work—but we had never built any. We made presentations in the government. It was during the [Dwight D.] Eisenhower administration, and [Charles E.] Wilson of General Motors was Secretary of Defense. I remember one day being in his big office in the Pentagon, with one hundred officers around there, making a flip chart presentation. Boy, I was shaking all over. Showing that, if they would put in the capital, we could produce liquid oxygen for the air force at a price that would, compared to the Linde price, get the government capital back in less than a year. So they made contracts with us to do that.

Then we started building those liquid plants. They were primitive and energy inefficient by today's standards, but they were the best we could do. We built—on the West Coast, in the Middle West, at Cape Canaveral over here, the Kennedy Space Center, and elsewhere—these plants with government capital. Then we had operating contracts to operate them.

Well, we were producing liquid oxygen on a scale that approached Union Carbide's. We said, "Oh boy, let's go in the commercial side." Here's where George made an enormous contribution. There were some sixty of these small entrepreneurial industrial gas companies in Pittsburgh, Cleveland, Denver, and every principal city in the country. Many were using these old fashioned gas plants that Anderson and the Gas Industries Company had made for them in the 1920s. The cost of producing—one hundred cubic feet was the standard unit of measurement of oxygen from those plants—was around twenty-five cents. We were producing it in these government liquid plants for a nickel.

So George set out. We didn't have any money, so he gave a little piece of cash and Air Products' stock, and acquired about nineteen of these companies, who had trucks and salesmen and so forth. Then we'd put in a new liquid-producing plant, based on the government know-how. That made the company just go through a very high rate of growth, and produced cash flow that permitted us to do other things.

BOHNING: At this point, you had no financial background as such. Yet there you were, in the Pentagon, presenting a case to Wilson. How did you feel? You said you were nervous about it. But how did you develop this ability to deal with the financial side?

DONLEY: Leonard had an intuitive feeling for the overall structure of a business. I think that growing up, in my teens, on the farm helped me with that. Now mind you, the farm was very impoverished. But a farmer had to do everything. He had to produce. He had to maintain quality control. He had to sell. He had to have the financing if he could buy a new tractor.

In those days in Michigan, boys who lived on farms were allowed to get a driver's license when they were fourteen years old. We had a few chickens on the farm. I started gathering those eggs, taking them to the city—it was thirty-odd miles to Detroit—and going door-to-door, selling these eggs. [laughter] Well, I found that I could sell more than we could produce.

[END OF TAPE, SIDE 2]

DONLEY: I started buying eggs from other farmers and candling them. I don't know if you know it—I wouldn't even have recognized the words then—but it was a quality control technique. I had to get a car that I could deliver these things in, so I bought a secondhand car. I debt financed it, really, by agreeing to give the owner a share of the profit from the eggs. I mean, we're talking about nickels and dimes and dollars, but the principles were the same. I think I learned from that experience when I was a boy.

BOHNING: That's very interesting. I've worked on farms, but I never thought of a farm in the sense that you've just described. It's certainly very appropriate.

You went to Europe, sometime in 1954, to examine a number of different gas-producing operations. Eventually this ended up, I believe, in Air Products licensing ammonia production.

DONLEY: Yes. What happened at that time was, the use of fertilizer on American farms was increasing. In Europe, they used massive amounts of nitrogen fertilizer, compared to this country. But the growth in the ammonia business really took off here during World War II. There were government plants for producing ammonia and ammonium nitrate for explosives, based on the same kind of contracts that we eventually had. In fact, our original contracts—to build and operate, under government contract, the liquid oxygen plants for the defense—were based on contract patterns that had been established during the war to produce ammonia for ammonium nitrate.

Then when the war ended, that ammonia capacity existed. Farms in this country began to use it more, and the demand grew. In Europe, we knew that they purified coke-oven gas to get the source of hydrogen for producing ammonia. We saw a potential market for that. So we went over there and looked at some plants in Germany, Britain, the Netherlands, Belgium, and France. Eventually, after several months, we entered into a contract with the Dutch state mines to get their know-how for doing that in the United States.

We began, and we sold plants to a U.S. Steel plant out in Utah and a couple places. But in the meantime, that business didn't develop as we had thought it might develop. The natural gas pipelines were being laid all over the country, and natural gas from Texas and the Louisiana Gulf coast was reaching out every place. The cost of reforming natural gas, as a source of hydrogen for ammonia, rendered the other business noncompetitive. So we didn't pursue that.

In the meantime, the Cold War had raised the opportunity for the liquid oxygen production, and that took up a lot of our attention. But we were always dabbling around in hydrogen. The hydrogen story grew out of that. It is, I think, an interesting story—maybe it's in *Out of Thin Air*; I'm not sure.

At first the U.S. military was operating these U-2 spy planes, remember, over the Soviet Union and elsewhere. They were operating on conventional jet fuel, and they could operate up to an altitude of twenty-five thousand feet or something. The American military knew that the Soviet anti-aircraft capability was improving. So the air force made a very secret development program with The Skunk Works out at Lockheed.

I've got this book. I've only read a little bit of it so far. It was clear that if you had hydrogen fuel, you could operate a jet engine on very thin fuel-air ratios and get up to sixty, seventy thousand feet. So they gave Lockheed the secret contract to develop a super U-2. They

gave us contracts to develop the liquid hydrogen, and they gave Pratt & Whitney the contract to develop the engine.

They gave Pratt & Whitney the contract for the engine. We had contracts, all highly classified. The first little, small unit was called Baby Bear. Then there was a bigger unit called Mama Bear, then a super unit called Papa Bear, which was hidden in the Florida Everglades to make the then-fantastic amount of thirty tons per day of liquid hydrogen for this program.

Well, we were going ahead full speed. Lockheed was going, Pratt & Whitney was going. The U-2 was shot down over Russia, and Eisenhower denied it. Then the Russians produced the pilot. It was an embarrassment to the United States, and the super U-2 program was canceled.

Our earlier explorations had shown that the Germans were experimenting with liquid hydrogen rockets. They were using liquid oxygen for the bombs on Britain, but they were doing experiments on very high altitude. It was clear from the science of rocketry that if you had liquid hydrogen for the upper stages, you could get into orbit and put up the space station or whatever. The availability of the liquid hydrogen then stimulated the R&D on liquid hydrogen rockets, and that drew us into the rocket field.

The aerospace companies did the development on the propulsion systems, but we built several large liquid hydrogen plants, with government contracts, in California and elsewhere. New Orleans, for the testing center, nearby. When we started putting in the facilities to produce hydrogen at New Orleans for the government contract—and we had plants there for producing oxygen for the government contracts, and nitrogen waste byproducts—we thought, "Hey, we've got hydrogen and nitrogen, we can make ammonia."

The ammonia production up until then was all based on the old Haber-Bosch process, with very high pressures. But American Cyanamid and others had developed catalysts which enabled getting ammonia synthesis to go at, say, two or three hundred pounds pressure. As the scale of the hydrogen and oxygen plants went up in size, we had departed from the old high-pressure reciprocating compressors, which were very expensive, and substituted centrifugal compressors.

We saw a way to cut the cost of producing ammonia using some of these byproducts, running at low pressure from—I don't remember the numbers anymore—maybe twenty dollars a ton to twelve dollars a ton, or something like that. We put in, at New Orleans, the first large-scale low-pressure ammonia plant. So we had a leading edge in that technology and application, but we didn't have the capacity to exploit that. We had too many other things—didn't have the people, and we were growing at fifteen percent a year, compounded—so others went on and developed that technology on a wide scale in the ammonia industry.

But then we took the liquid hydrogen and began commercial development for selling that to the private sector. In due course, Linde came along behind us. But we have a dominant position in that liquid hydrogen market—worldwide now—and it's a big business. It's probably one billion dollars worldwide, in the commercial side.

BOHNING: I would like to ask you about fluorine for the space program. However, let me divert for a moment. When you develop a new area, like liquid hydrogen, that's a whole new step in technology that you have to develop.

DONLEY: Yes.

BOHNING: Oxygen was a principal factor in the growth of Air Products. However, the technology has to be quite different for hydrogen and fluorine. How do you handle that? How do you find people who will do that?

DONLEY: Well, it was a perpetual struggle. But you put your finger on the thing—the people are the key issue. We recognized that. I guess from 1950 on, for thirty-five years, a year never went by when I wasn't on several college campuses lecturing to engineering and science students. Really, recruiting is what it was, although we didn't call it that. Encouraging everybody else in the company to do it. A lot of people don't like to do that. We had some very good, active participants—Dexter [F. Baker] was one. But some people in the company didn't like to do that—particularly, the technical recruiting side.

We had to search out some people with specific skills that we didn't have. Jim [James F.] Roth was one. P. L. Thibaut Brian was enormously valuable. I don't know if you know about him. You know about Jim Roth?

BOHNING: Yes.

DONLEY: It was hard to recruit a person like Jim Roth. We didn't have a community of peers, so that was hard to do. But then, he was a valuable person. Thibaut retired about a year or so ago—he was sixty-five years old. He was a Louisiana boy. He went to LSU. Then he went to MIT, got a master's and doctor's degree in chemical engineering, was on the MIT faculty, and was a consultant for us. Finally, we recruited him and induced him to come to Air Products. He changed the nature of engineering in the company.

Thibaut was not a manager. But Thibaut Brian knows—and knew then—the fundamental academic principles of graduate schools of chemical engineering. He brought that know-how, and then brought several others along. He professionalized the engineering side of the company.

Nat [C.] Robertson did the same thing on the chemistry side. Nat Robertson retired several years ago, too. He is a chemist with a Ph.D. from Princeton. He was in the old Spencer Chemical Company—that's where we met him, with the ammonia production—and then they were acquired by Gulf Oil. That giant corporation, with their hundreds of scientists and so forth—Nat didn't care for that. We got him to come. He had the title, for several years, of vice president of research and development.

Nat was like Thibaut—not a manager, but rather a person who brought the understanding of the professional chemist. Nat is a shy kind of person. He didn't like to go out and deal with the commercial world. But he had an innate judgment whether this R&D effort would lead to commercial success. So those two men played very instrumental roles in helping us professionalize those sectors.

BOHNING: When you're out on a college campus, recruiting young engineers just getting their degrees, what do you look for? How do you tell that someone's going to fit into the culture of Air Products?

DONLEY: Well, I always felt—and we'd adhere to this—that the person with academic excellence was primary. Now if, in addition, he—they were mostly he in those days—had other campus activities, was involved in lots of things, and had leadership, that made it ever more attractive. We set very vigorous standards. We didn't offer unless people were at the very top of their class. I mean, some of the practices we followed, you'd get into trouble with the EEO people about, today. But that's what we did. [short break]

The recruiting—I think it's very important to think about that. The recruiting of these really gifted people—people who were at the top of their class academically and had other skills—doing that year after year. If you read security analyst reports, over the years that's been frequently cited as the thing that has led to preventive depth and breadth of management in the company.

You can see it now. Dexter ran the company after I did, and Hap [Harold A.] Wagner does now. Those guys were products of that system. They're surrounded by people who were counterparts of them during their same chronology.

BOHNING: I don't think this person would fit into what you're saying—but sometimes you're going to find someone who's quite brilliant, but prefers to work alone as opposed to interacting with others.

DONLEY: That's right, yes.

BOHNING: How do you deal with that situation?

DONLEY: With a lot of those people, sometimes it doesn't work out, you know. I began this recruiting when I was still at Lawrence Tech. The guy who was the valedictorian of our class, Arthur Harbeck—I recruited him. He came to Air Products, but he didn't stick around. He just didn't have the dynamic personality. The person who did was Jack Graeffe.

This is such an interesting human relations story that I ought to tell you that. When I went to Lawrence Tech in 1939, one of the people I first encountered was this fellow, Jack Graeffe. He was six months younger than I, something like that, and he didn't speak any English. He had just come from Germany. They were not Jews, but his mother hated Hitler. She smuggled this seventeen-year-old boy out of Germany and came to Detroit, where her brother was one of the people with Dr. Lawrence in the faculty.

Jack was trying to go to engineering school and learn English at the same time. I went on through and got my degree in four years. It took him five years to get his degree, because he was learning English. But about the time I came to work at Air Products, why, I got him to come to work at Air Products. He worked part-time, and when he got his degree, he worked full time. Then we went to Tennessee, and we were both deferred. He had applied for and become a citizen. We were both deferred during the war. Then when the war ended, that was it as far as I was concerned. But within two or three weeks from the time the war ended, Jack was drafted.

They put him in military intelligence back in his hometown of Stuttgart, where he could talk to the Germans just like—well, he was a German. [laughter] He was in the service for two or three years. Then he came to Pennsylvania, met a girl there, married, and had four children, in fact. The sad part was that Jack had severe arterial problems and these blood clots like Dan [J. Danforth] Quayle just had, except Jack had them in spades.

He and his wife and their small children were sent over to England. He was in charge of the engineering department in Great Britain. He'd have these severe, life-threatening illnesses, where he would have to go in the hospital and they'd dissolve this thing. He came over here, and he went to Houston to the DeBakey Heart Center. They told him that they had an experimental system. They could take an artery, I guess, and they would go into his thigh, where he had the most severe problems, and they'd put this experimental plastic tubing in there.

If he didn't do that, he stood a chance of dying a sudden death. But—because they didn't know if they would be able to do it successfully—before going under the anesthesia, he would have to sign a release so that if necessary, they would amputate his leg.

Well, he came up to our home in Allentown—Inez and I were there—on a Saturday, and he stayed overnight. Friday night he stayed, and all day Saturday, agonizing over this decision. He wanted me to give him some advice, which I absolutely wouldn't do. Finally, he called Gloria [Graeffe], his wife, in London and asked her to take a flight to Houston. They'd meet there Monday, and they'd go through with this.

Saturday afternoon, I had a company car take him to Kennedy Airport for a flight to Houston. He wanted to go from Kennedy. Monday morning he called me, and he was back in London. He'd gotten to Kennedy—I think that's why he wanted to go to Kennedy in the first place—decided he didn't want to do it, called his wife, and took a flight to London. Well, six or seven months later, we were building a plant in Finland. Jack was in a hotel in Helsinki. In the middle of the night, he called the desk and said, "Send a doctor." They sent a doctor, and he was dead.

His wife then came home. In the meantime, I told you earlier that Leonard Pool's wife had died. Gloria Graeffe came home with their four children. Leonard's wife had been gone for a few years. They started dating and were married. They'd known each other for all those years. They were married. They were married for ten years or so, I guess, before Leonard died. That's how, in these little companies, people get intertwined with each other.

BOHNING: Oh, yes.

Well, let me follow that for a moment. Would you say that Air Products, as it grew, had a family orientation to it?

DONLEY: Yes. It doesn't have that anymore, and I didn't try to preserve that. In fact, I introduced rules that were toward professionalization. I introduced rules against the employment of relatives—of children of employees, for example. If we had spouses working in the company, one didn't report to the other, but worked in different departments, and movements of that kind. It was getting too big to operate, is what I thought—and I think I was right—as a family structure. It needed to have a professional management structure. [short break]

BOHNING: Were you instrumental in urging that the company get into chemicals?

[END OF TAPE, SIDE 3]

DONLEY: Yes. We got to the point then, where we were generating, not insufficient cash flow, which we had been in the beginning, but excess cash flow. There were several reasons for that. We had cash flow coming from these now very large government contracts, where we didn't have capital investment. The on-site plants had grown very large for the steel industry and the petroleum industry. The way we worked in those cases was, we would get a fifteen-year contract—say, from a major steel company or a major oil company—to supply a given amount of gas on a daily basis. In those days, the credit of the steel industry—and the oil industry, too—was so great that we could take that contract to an insurance company and get the capital for building the plant.

Under the Internal Revenue Service, we had an eleven-year depreciation on these plants. We had a new investment tax credit at certain times, and we had a double declining-balance depreciation. So we were generating far more cash than it took to pay the loan to the insurance company. What to do with this cash? Well, there was a big hassle about that at that time. Some of the outside directors said, "Pay the dividends to the stockholders." A real estate venture in Florida was started by U.S. Steel. If you recall, in that period, lots of big companies—U.S. Steel, Westinghouse, and others—went into real estate development businesses. We considered similar ventures.

I thought, "We have built up a technical capability in engineering. The thing that's closest to what we're doing in the industrial gas, hydrogen and all those things"—and we had the ammonia; we had a little toehold in chemicals. "We have a technology link into the chemical industry." So we started trying to develop a chemical business.

We didn't have the technology. We licensed some technology from Europe. We built a plant in Delaware City to make plastics additives. We got a license from Kuhlman in Europe. Then we acquired this company in Florida, Escambia Chemical Company. We did it mostly by acquisition. Then we took these businesses that hadn't had an adequate infusion of capital, hadn't had an adequate infusion of management and technology, and we jazzed them up somewhat. That's a very successful part of the company now.

BOHNING: The company name was changed to Air Products and Chemicals, Inc.

DONLEY: They changed the name of the company, yes. Right.

BOHNING: I'm not sure when that occurred.

DONLEY: Oh, it was probably 1960, something like that.

BOHNING: You acquired Houdry Process Corporation at that time.

DONLEY: We acquired Houdry. Houdry had been a part of Sun Oil Company. They had done research and developed catalytic cracking, and so forth. Sun was accused of having a conflict of interest because they had their own research. Houdry had some public shareholders, so they wanted to sell it. We thought, "That's wonderful. That's what we need, a research capability." So we bought it from them.

It turned out that it was a misjudgment, although it was a marvelous misjudgment. The Houdry research had grown old—it really wasn't currently productive research. But they had all these licenses for various hydrocarbon products, like cracking technology, butadiene, and other things. In the third world—in Asia, in Eastern Europe, and the Soviet Union—they wanted those technologies. That turned out to be a tremendous cash cow, where we licensed all those and got increased amounts of cash flow. We didn't anticipate it. But that's the way it fell out. It was just a lucky situation.

BOHNING: Ted [Theodore A.] Burtis came along with Houdry, didn't he?

DONLEY: Yes.

BOHNING: He left, however.

DONLEY: Ted came. He was the head of Houdry. Then he was recruited by Sun to come back and become chairman of Sun Oil.

BOHNING: This statement in *Out of Thin Air* says the following. "The decline of Dabco—and of Houdry in general—was one less-happy consequence of the Air Products culture. That culture was inhospitable to the style of research on which Houdry had depended for its innovations" (1).

DONLEY: Yes, that's true. The Houdry people were older, for one thing, and they didn't have the commercial orientation. Dr. [Eugene J.] Houdry had run it. The commercial approach of

Houdry was to develop some leading-edge thing—which they were leading-edge at the time they developed them—but then, license them to others. Those guys were in their fifties, and most of us were in our thirties. It wasn't possible. The culture is a very powerful thing—boy, I learned that, in that experience—to get those folks to change.

We had a tremendous debate, shortly after we acquired Houdry. That's when we started this plastics additives business, see—oxo-alcohol, that I mentioned. Here's what we did. We didn't have the technology, so we licensed it from Kuhlman. We didn't have the feedstock, so we made Getty Oil a joint venture to provide the feedstock. We didn't have a market, so we entered into a contract with Reichhold Chemical Company to take the output. We took the Reichhold contract to the insurance company. We got the capital on high-ratio debt. The return on the net worth that we invested there was just fabulous.

The Houdry guys, when we were putting this deal together, said, "We don't want to be any part of it. That won't work. You're not contributing anything—somebody else's technology, somebody else's market." "Yes, we're contributing something. We're contributing the entrepreneurship." [laughter] That was a foreign language. We never got together on that.

BOHNING: By 1973, Leonard Pool had finally turned everything over to you.

DONLEY: Yes.

BOHNING: I think he died a few years after that. However, prior to that point, he still considered it his company. Is that correct?

DONLEY: Oh, yes. After his first wife Dorothy's death, he turned his attention to the health care thing. Besides leading Air Products, he left another precious heritage in the Lehigh Valley, and that's the health care system. Lehigh Valley Hospital is now the largest hospital in Pennsylvania. It's enormously successful. He created all that so that the people in a community like that could have health care the quality that she was able to get by going to Sloan-Kettering Hospital.

During the past ten or fifteen years of his life—I'm sure to the day he died—he considered Air Products his baby. But he had made up his mind that he wanted the team, me and others, to run it—and that's the way he did. He was, in those latter years of his life, doing for the hospital what he had done in early years for the company. He ran that hospital business. Some of the people over there told me he called in the general manager one day and pointed out to him that there were squeaking doors in some of the hospital rooms. [laughter]

BOHNING: He was that detailed at Air Products too, I'm sure.

DONLEY: In the beginning, yes.

BOHNING: When was it, in your career with Air Products, that you finally realized that Leonard Pool had tapped you to be his successor?

DONLEY: Well, I don't know if it happened. I didn't have a blinding light strike me on any one particular day. But Dorothy played an important role in it—his first wife. She was an enormously gifted, dedicated woman. She helped him. Leonard was a very mercurial guy. He'd have ups and downs, psychologically. She was a very stable, steady influence. She had a campaign going with him very early, actually. She wanted to retire, so he and she could go away somewhere and relax a little. That would never have happened. That wasn't in his temperament. But she wanted him to have me take more responsibility, over quite a long period of time.

I should mention this. The company really consists now of three parts—the industrial gas, the chemistry, and the environmental systems. We never considered that part of our business, the environment. I said I wasn't struck by blinding light at any one time, in regard to taking more responsibility. But on that first Earth Day, which was probably twenty-five years ago, I happened to be in New York City. If you recall, Fifth Avenue was closed down. There were tens of thousands, maybe one hundred thousand people—mostly young people—sitting on Fifth Avenue in the street, singing songs about the environment. I said, "This is a movement that has enormous force in this country."

That one experience did have an impact upon me. I started talking to our research guys, looking for ways that we could license some technology in Europe and Japan. Actually, you know, they'd been more advanced than we were. We developed, then, some biological processes which would permit the use of oxygen to develop biological species for tertiary cleanup of sewage. We thought that was going to be a good business. It would have been a good business. We did make a couple of them, one in Largo, Florida—where we would contract with the municipality, on a long-term contract, to treat their sewage.

But then, the movement had so much force that the federal government started pumping money in. Instead of the municipalities contracting with a company like us to put the capital in and perform the service, they got the federal money. The plants were run by municipalities—in most cases, not very well. So that business didn't turn out to have the commercial appeal. But we did others—the solid waste to energy, and the scrubbers for the stack gases. That's a third part of the company that's really got enormous prospects now.

BOHNING: You've made an interesting comment. When Earth Day and the public concern about the environment became obvious to the chemical industry, some companies tried to stonewall as they did when Rachel Carson's book, *Silent Spring*, was published (3). Ted [Herbert D.] Doan has told me that at Dow Chemical Company, people were worried. But he told them, "No, we can turn this into something positive." That sounds exactly like what you're saying.

DONLEY: Yes, right.

BOHNING: What did you sense were the reactions of your counterparts in the rest of the industry?

DONLEY: I sensed them like you say. But I was inspired by Ted Doan and by [Carl] Gerstacker. They were strong advocates of exactly what you said. Then I was going around in the Chemical Manufacturers Association making speeches. I took over the chairmanship of the environmental committee in the U.S. Chamber of Commerce, to try and bring the industry around. I was making speeches those times saying, "Sure it costs a buck to improve the environment. But the buck isn't spent on the moon, it's spent here with another company. Let's find out how to take advantage of that."

BOHNING: When you took over in 1973—in the sense that Leonard Pool had finally turned things over to you—one of the things you did was to introduce the matrix management concept. I'm not sure whether that came out of your Harvard Business School experience or not.

DONLEY: No, I don't remember ever hearing about that at Harvard Business School. If I were in the company today, I would abolish matrix management. You just can't do that; it's too expensive. But in those times, we were growing so rapidly—and we had so many inexperienced people—that we made mistakes, and some of them were quite costly. So I was trying to develop a way that we could have checks and balances. That's what we called matrix management.

It grew out of what we wanted. Leonard said, "Ed Donley is going to be vice president and general manager." Well, what did that mean? We had guys like George; Carl Anderson, who was twenty-five years older than I; Clarence [J.] Schilling, who was one of the old stalwart people with a technical background; and Frank [E.] Pavlis—old-guard guys who were part of Leonard's original team. I was quite a lot younger than they. I wasn't in a position to be their boss. So I began devising a structure—proposing it to Leonard and to them—where those guys

would continue to report directly to Leonard, not to me. That was important to them. It was inappropriate to ask them to report to me, anyway.

If you use what's common terminology today, I'd be chief operating officer. I'd be the line officer managing the business. They'd be staff experts, giving advice to me and to the other people who reported to me, in their field of technical expertise. In order to get that staff knowledge utilized, we had to have what we called a matrix. The line people would run the company, but they'd get advice and consultation from the staff people.

BOHNING: That must have been quite a change for many of those people.

DONLEY: Yes, it was. It was very hard to get it done. But I think it was the right thing that was needed at that time. The company today is entirely different. It's got people who have been in their jobs for ten, twenty years. We grew, for many years there, at a compound rate of fifteen percent. So we doubled every five years, doubled again, and doubled again. We were having people do things that they didn't have any experience doing.

BOHNING: Several other things happened at that time. You stressed the role of engineering in long-term planning, as well as the importance of it in decision making. How did you encourage decision making at a lower management level? Earlier, everybody had gone to Leonard Pool. That wasn't the case anymore.

DONLEY: Well, you see, I have tremendous admiration for Carl Anderson. He is a person of enormous integrity. In an organization where Anderson was president, his moral authority would be so high that there would never be any corner cutting. That was a contribution of integrity that he brought to the corporation as it grew. That was his strength. But I guess you would call it a weakness in that Anderson said over and over, "I'm an engineer. Management has to tell us what to engineer, and then we'll engineer it." I didn't think that was the right thing to do. I thought the engineer should be part of management; the other people should be part of management; the finance professionals should be part of management; and so forth. It was that kind of old-style authoritarian direction from the top that I thought ought to be broken down. That was what I was trying to do, without ever being offending. I never would have said anything derogatory to or about Carl Anderson.

BOHNING: Another thing that you encouraged at that time was combining an MBA degree with an engineering degree.

DONLEY: Yes. Well, part of the same syndrome, I think. A lot of those MBA guys have done enormously well in the company. MBAs are unfashionable today, but that whole top management group now are guys with engineering and MBA degrees.

BOHNING: I don't remember whether that was unusual for that particular time. Were you one of the leaders in that movement of combining a technical degree with an MBA?

DONLEY: I don't think too much. I think there was a time when it was very popular. There was a lot of competition for MBAs in those days, because it was so popular and fashionable. But a lot went to Wall Street, and a lot went into consulting firms and got enormous salaries. It was hard for manufacturing companies to attract them. But we had an advantage that many, many manufacturers didn't have, in that we were growing so rapidly. "This company is size X now. But in five years, it's going to be 2X, and in ten years, it's going to be 4X." So it enabled us to recruit not just MBAs, but the top people in all categories.

BOHNING: You had plenty of opportunities to offer people.

DONLEY: Yes, and we had the image. We were perceived as having opportunity.

BOHNING: You also brought back something that Leonard Pool had introduced earlier, called the career development program.

DONLEY: Yes. We did that. We always did that. The essence of it was that we recognized always that there are some professionals in science, engineering, accounting, tax policy, or whatever—some people, law. Some people may have a certain professional discipline that they want to follow. That's their career objective. But for someone who's going to be a general officer of the company—chairman, president, vice president, or whatever—he will be able to do those jobs more effectively if he has diversified experience.

So we used to have what we called double-diamond charts. They would chart the theoretical progression of a person through his career. If he went straight through without taking these diversified experiences on the double diamond, he wouldn't be as well equipped—at age forty-five, or whatever—to take on more responsibility. We put it all, eventually, on computers. If a person worked for five years in a given discipline with no diversified experience, that printed up on a computer program. His supervisor had to say why that was so. We recognized it may be very legitimate. It may be the right thing for that person. But we didn't want to let people drift into not having diversified experience. That's what that was

basically all about. It's done yet today. I haven't talked to Hap or those guys about it lately, but it's kind of embedded in the culture of the company.

[END OF TAPE, SIDE 4]

BOHNING: You ran into some safety problems. At one point, you put a lot of effort into turning the whole thing around. Safety had declined within the company.

DONLEY: I don't know if it had declined. I think we deluded ourselves. We paid lip service to safety, and we really believed that we had a safe program. But then Thibaut made it possible to do this. I said, "Thibaut, I want to see the measured statistics of how good our safety record is and how we compare to other companies." He got them from various sources, and we really got out on the table the facts about safety, which we'd always said we were good at. The facts showed we weren't. Industry overall wasn't very good at safety. So we then moved it very high on the priority of the management of the company. I set up a system where we had a management committee meeting every Monday morning. The first thing on the management committee was to be the safety performance. We put it right up on the board in the various departments in the divisions, what the safety record was. The camouflage was stripped away, and it got to be very good. We have one of the best records in the world now.

BOHNING: If I remember correctly, you either worked with DuPont or used the DuPont system.

DONLEY: We brought DuPont in as a consultant. That's correct, yes.

BOHNING: They've had a longstanding reputation, in the industry, of being extremely safety conscious.

DONLEY: Yes, that's right. Absolutely. What we had to do was raise the consciousness of the managers, and of the people at all levels, about the importance of this. That's what the system did.

BOHNING: You brought in Dexter Baker. You originally hired him, didn't you?

DONLEY: I think so. My memory is not absolutely certain about that. Dexter had a degree in engineering from Lehigh. He had a really good commercial sense from the very beginning. When we were growing very rapidly here, and we were growing very rapidly in Europe, we didn't have adequate management capacity in Europe. Then it was decided that, although we needed Dexter badly here, we needed somebody really strong over there. So we sent him over. Dexter stayed there for ten or twelve years and really created Air Products Europe from a little small thing to parallel the American experience.

BOHNING: In 1968, he became executive vice president, I believe. Around that time, you hired Dick [Richard] Fleming to run the chemicals business.

DONLEY: Yes.

BOHNING: You reorganized the chemicals business about seven years later. Fleming left about that time.

DONLEY: Yes. Well, what was going on then is that the main body in the chemical group grew out of the Houdry acquisition. It was located in Philadelphia. Dick Fleming, who is a very strong man—he is a strong, strong person—wanted to build his own company. Of course, it was owned by Air Products. But if Dick could have seen a way to have it owned by somebody else and be really independent, he would have liked to have done that. So it was emerging, then, that there was really a competitive rivalry—which is a good thing to a certain degree, but this became too competitive. I concluded that, unless a specific effort was made to bring the company into one unified company with operating groups, it would fracture. So we moved the chemical group headquarters from Philadelphia to Allentown. That melding process went forward from that time. Dick wasn't satisfied about it and he, in due course, left.

BOHNING: You always have emphasized, not only in your own personal aspects but in Air Products as well, the relationship of the company to the community.

DONLEY: Yes. I got this for you. They just wrote an article in the newspaper (4). Have you seen that?

BOHNING: No.

DONLEY: Take it with you. That's a xerox copy of an article that the Allentown newspaper ran a month or so ago—telling what I've done since I retired, with this education reform business. This is a post-retirement extension of what I always thought should be the role of the corporate executive, and the corporation, in the community.

BOHNING: There is one other thing I wanted to discuss. That is the corporate science center, which was started around 1980, I believe.

DONLEY: That's when we got Jim.

BOHNING: Yes. What was the background of that?

DONLEY: Well, when we started out, there were no real professional disciplines there. Everybody did everything, and Leonard decided what they should do. But then, as it became bigger, we had to have a degree of discipline based on segmentation of skills. The professionalization of the various skills took place at different times, depending on what the needs of the company were. I'd say the first thing that achieved professional stature—the first discipline—was sales and marketing. Then engineering. Finance came later. Research came toward the end. We didn't really have a professional research function. But as I said earlier, Nat Robertson brought us the know-how about how to do that. Nat recruited Jim Roth, and others with the professional skill of Jim Roth—Bob [J. Robert] Lovett then, and Brian [M.] Rushton—those were some of the stars who grew out of the Robertson heritage. The creation of the science center was an attempt to really create a world-class professional research capability.

BOHNING: Just before retirement, you essentially cleaned house a little bit.

DONLEY: Yes.

BOHNING: What was your thinking in doing this?

DONLEY: Well, we were entrepreneurs, and we'd created a lot of entrepreneurial activities. Not all of them were successful. Some were; some weren't. Some were marginal. I felt, as I approached retirement, that it would be statesman-like, really—and my responsibility—to hand my successors a clean operation. If I'd been ten years younger and I were going to have the job for another ten years, I think some of the things could have been cleaned up and improved. But

I didn't want to leave them hanging there. So I decided that it would be preferable—I recommended it to the board, and they agreed—that we take and clean house, is what I think you've said. So that my successor, Dexter, would inherit a rock-solid, rock-hard balance sheet with no soft assets in it. We took those steps and did it.

I'm glad that we did. I've seen other companies that didn't do it. The Borden case comes to mind. There's a sad case where those managers should have cleaned up a number of those things, not let them linger. There are many others you can point out.

BOHNING: If you're going to be an entrepreneur, you need to take risks somewhere along the line. You commented about that in your address to the Chemical Industry at the time of your award (5). You talked about risk taking. But at that point, you also seemed somewhat pessimistic about the future.

DONLEY: Well, I don't remember if I was pessimistic, or why I should have been.

BOHNING: I'm quoting here, "The future of our way of life is at stake."

DONLEY: Well basically, even yet today, I'm optimistic that we're going to solve our problems. But we've got real big problems. I think that we've got this new political system here in both our state and our country. I don't think we're dealing with the correct issues, though. Education—I'm committed to that—it's hard to fix. We're making slow, agonizing progress, but it's going to take decades to fix the K-12 education system in this country.

Underlining it all, in my view—and hardly anybody says this—is that we're not investing, in the United States, enough capital. Capital no longer has any nationality. It's a world commodity. For more than twenty years now, the rate of new capital investment as a percent of gross national product in Asia is double the United States. In Europe, it's half again as high as the United States. We see declining middle-class incomes. We see middle-class tax cuts. We see battles about health care, and so forth.

Fundamentally, we're not creating <u>wealth</u> at a rapid enough rate. Our whole economy is directed toward consumption. Our government is directed towards consumption, rather than capital formation. That's a tough issue, but eventually, we have to deal with that. I am optimistic that we will, but I'm pessimistic about how long it's taking us to recognize it. Pete Peterson is talking about that. He is president of the Concord Coalition.

Did Ralph Landau ever receive this SCI award?

BOHNING: The Perkin Medal.

DONLEY: He's connected with a group who is advocating capital formation. I think they're right on target. But [Newton L.] Gingrich is not talking about it, and [William J.] Clinton is sure as hell not talking about it.

BOHNING: How do the new trade agreements affect the chemical industry?

DONLEY: Well, they're good. As you know, the chemical industry has always had a positive balance of payments. Whatever fosters easier world trade is good for the chemical industry. I think it's good for the country—although, of course, in the area where we live, the remnants of the textile workers are going to be out of work.

I don't want to delay, but Inez and I were over here in the shopping mall just before Christmas. I went through some of those shops—you know, children's clothing and so forth. I looked and I looked, and I couldn't find anything that had a USA label on it—Hong Kong, Singapore, Romania, you name it.

BOHNING: Well, the Wilkes-Barre area had a big garment base when I first lived there. Now it's all disappeared.

Let me just turn to some of the questions on this sheet that I've sent you. We've covered a number of these already. What does scientific innovation mean to you, as derived from your experiences?

DONLEY: We practiced our careers in a different time than it is today. We were working in the field of more or less engineering innovation. We wouldn't have invented a computer chip, or the transistor, or a real breakthrough science thing. We were pushing back the margins from an engineering standpoint. If we hadn't done that, we wouldn't have been successful. I mean, it's like Adam Urbanski, president of the Rochester Teachers Association, says, "If you always do what you always did, you always get what you always got." [laughter] It's the heartbeat of what makes success, but to get it, you've got to have the people.

BOHNING: Do you think that it's the economics that drives innovation?

DONLEY: Sure, yes. The people are in it for the money. But that's a simplistic answer. I think it's fair to say that making money wasn't the motivating, driving factor to me, as a person. It sure wasn't to Leonard Pool. I mean, the money was sort of an afterthought. I think that the biggest driving force is some innate thing that exists in the human spirit.

BOHNING: What about changes in management agendas, during your long career as a manager?

DONLEY: Well, certainly, the management agenda has changed to be less authoritarian than it was when I was young and Air Products was young, but we were dealing with older companies—like the steel industry, for example. There was a top-down authoritarian management structure. The boss was driven to work in a limousine in the morning, and those artifacts of authority were made very prominent. Those days are gone. We're a far more egalitarian society, and there's strength in that.

BOHNING: We've talked about public issues, such as environmental concerns, as well as a little bit about government relations. I have read that you were concerned about over-regulation on the part of the federal government.

DONLEY: Oh, I think it's far too much, and I think we're seeing a backlash against it now. That was a major factor in the election. We're going to see a substantial curtailment.

When I chaired the environmental committee in the U.S. Chamber, I advocated to Juanita Kreps, who was Secretary of Commerce, that we exercise a cost-benefit ratio analysis on all new environmental regulations. That was considered anathema in those times, in the [James E.] Carter administration. But now, Gingrich and these guys are advocating that—and the EPA man is under attack. So we're going to have to examine the cost of government regulations much more carefully than we did in the past. It's grown too big—I'm convinced of that. It's soaking up capital. Government can't make the judgments on how best to deploy capital. You have to get government out to a greater extent.

BOHNING: I interviewed someone whose father had started the company. At one point, when his father was in his late eighties, he went to an affair where there were a number of people. He said, "Who are all these people?" His son said, "Well, they're the lawyers, and they're the environmental people." He said, "But they're not selling anything" (6). [laughter] In that case, you have a large group of employees and operations who are virtually nonproductive.

DONLEY: Yes, that's right. Our two sons are lawyers, and they're part of their generation. As you know, we graduate twice as many lawyers here as they do in Japan, on a per capita basis, and half as many engineers.

Incidentally, we made an analysis—I sent this to Ralph Landau—of this. If you raise the rate of new capital investment in the United States to the level it is in Japan—and we know the percent of capital that has to go into designing the machinery and everything—presto, we would have to graduate twice as many engineers as we do. Presto, if engineering became the field to study, there'd be fewer people going to law school. So the allocation of capital, I'm convinced, affects the basic social structure of the society.

BOHNING: In the 1930s and 1940s, everybody viewed science and engineering as being the saviors of the world, coming out of the war and the Depression. We had all of these great opportunities, thanks to them. Now chemistry is a dirty word. Very few companies are left that still have the word chemical in their name.

DONLEY: Yes, right. An analyst told me once, "You could get another two points in the P/E ratio if you would change your name back to Air Products.

BOHNING: That's interesting. [laughter] I know there was, at one point, a suggestion that Dow would drop the word "chemical," but that didn't happen. A number of people were adamant that they keep the name as the Dow Chemical Company. But DuPont has changed. DuPont dropped it, and I think Monsanto Company dropped it, and others as well.

We're approaching eleven o'clock, so I think at this point I'll close. Thank you for the time you spent with us this morning.

DONLEY: Well, it's been very interesting to talk to you, and I thank you for coming. If you think about this, and anything comes you want to talk about further, why, just call me.

BOHNING: Okay, maybe we'll do that. Again, I appreciate the time you spent this morning.

DONLEY: I'm glad to do it.

[END OF TAPE, SIDE 5]

[END OF INTERVIEW]

NOTES

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2. Ben R. Rice and Leo Janos, *Skunk Works* (Boston: Little, Brown & Co., 1994).

3. Rachel Carson, *Silent Spring* (Greenwich: Fawcett Publications, 1962).

4. Susan Snyder, "Making Strides: Ed Donley's Goal in Retirement: Improve Education," *The Morning Call*, Sunday, November 13, 1994. See Chemical Heritage Foundation Research File #0130.

5. Edward J. Donley, "What Future America? Chemical Industry Medal Address," *Chemistry and Industry*, 20 December (1980): 929-930.

6. William Wishnick, interview by James J. Bohning at Witco Corporation, 13 May 1991 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript #0093).

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